

5.4 Agriculture and the Environment

5.42 Agriculture is one of the most important economic activities and it is essential to sustaining livelihoods, securing food production and providing income.

Agriculture is an environment-dependent activity that involves the use of ecosystem goods and services and environmental resources such as land, soil, water, and energy. Agriculture is the largest water consumer in the world.

5.43 Sustainable agricultural production contributes to long-term food security. The promotion and support of sustainable agriculture that conserves land, water, biodiversity and ecosystems, while enhancing resilience to climate change and natural disasters, has been agreed upon internationally, as has the need to maintain natural ecological processes¹.

5.44 Large scale or intensive agriculture requires the increasing use of chemicals, infrastructure and machinery. In its race to improve crop production, agriculture has become an industry which uses more and more anthropogenic inputs in the form of chemical fertilizers, pesticides, and modified genetic material. Changes to soil chemistry through fertilizer and pesticide concentrations, as well as alteration of ecosystems and biota through introduction of genetic material all influence the wellbeing and health of humans and other living beings.

Agricultural infrastructure (e.g., access roads and networks for delivery of products), immovable irrigation infrastructure, dam construction for access to water resources, as well as wind and solar energy infrastructure for exploiting groundwater resources, all contribute to changes in the ecosystems.

5.45 Advances in agricultural production in recent decades have been realised with little or no regard to biodiversity. Many modern agricultural practices which intensify a given crop's production yields have led to gross simplification of agricultural systems and biodiversity leading to an increasing need for conservation efforts of existing biodiversity.

5.46 Agriculture both contributes to and is seriously influenced by climate change. It leads to GHG emissions by decreasing carbon sinks (via deforestation and wetland conversion), contributing to methane emissions (via rice cultivation and ruminant livestock), releasing nitrous oxide through nitrogen fertilizers, and emitting carbon dioxide via machinery and transport. In turn, as a result of climate change, agriculture is subjected to changes in water availability, increased exposure to heat stress, changed distribution of pests and diseases, increased leaching of nutrients from soil, greater soil erosion from stronger winds and rainfall, and an increased frequency of wildfires.

5.47 Flows and balances of nutrients and their contribution to soil fertility are critical to agricultural production. Globally, human society has already more than doubled worldwide terrestrial cycling of nitrogen and phosphorus, and caused an imbalance in these nutrients which is leading to environmental problems such as soil degradation and loss of soil fertility. Improving nutrient efficiency in crop and animal production is integral to mitigating this problem.

5.48 Regarding livestock production, growth and productivity gains are frequently

¹ United Nations, 2012, "Resolution Adopted by the General Assembly, 66/288. The future we want". Available from <http://daccessdds-ny.un.org/doc/UNDOC/GEN/N11/476/10/PDF/N1147610.pdf?OpenElement> (accessed 2 January 2013)

achieved through the use of chemicals, antibiotics, hormones, genetic material, and intensive feeding practices on pasture, rangeland and feedlots. Bacteria in poultry litter, veterinary antibiotics, anti-parasitic medicines and hormones are just a fraction of the contaminants that are introduced to the environment through livestock production. The cumulative effect of releases from livestock production and agriculture make monitoring of the environmental consequences a pressing need.

Application of the FDES to agriculture and the environment

5.49 In the following, the scope of agriculture is set according to groups 011 through 016 in ISIC Rev. 4, which comprise crop and animal production². Although the scope is restricted to these contents, using the pattern applied below similar exercises can be made about forestry, aquaculture and agro-industrial activities and their relationship to the environment.

5.50 Figure 5.11 is a schematic presentation of the relations between agriculture and the environment. The scheme also helps to illustrate how the FDES can be applied to study these relationships.

5.51 Environmental conditions and quality (FDES Component 1) largely determine the agricultural potential of a country, for these environmental conditions (such as climate and weather, hydrological conditions, terrain, soil types and fertility levels etc.) actually provide the basic ecological support for agriculture.

5.52 Agricultural production uses environmental resources (FDES Component 2) such as land, soil, water and energy. In this use the resources are modified both qualitatively and quantitatively, for example water can become polluted and overused compared to locally available stocks, or nutrients from soil can be depleted and would require replenishment by artificial means. Other natural inputs are also necessary to produce crops and livestock output, namely the permanent flux of solar luminescence, the continued photosynthesis processes and a wide range of other provisioning and regulating ecosystem services.

5.53 In addition to natural inputs, other inputs that originate in the economy such as fertilizers, pesticides and other agrochemicals, as well as inputs used in livestock production (antibiotics, hormones, etc.) are also used in agricultural production and released to the environment.

5.54 The production of the different types of crops and livestock (FDES Component 2) might be carried out by different methods such as traditional, extensive, monocultural, or organic, and therefore the intake of resources and agrochemicals as well as the residuals could be more, or less sustainable, depending on the state, conditions and the resilience of surrounding environments. Informing about the yields and monitoring their changes through time and space provides additional information to assess the sustainability and health of ecosystems.

5.55 Agricultural processes generate different kinds of residuals (FDES Component 3). Emissions to water occur from the use of agrochemicals. Also important, particularly in terms of contributing to climate change, are the agricultural emissions to air and atmosphere resulting from both land use change associated with agriculture (i.e., deforestation), from the use of fossil fuels for energy and

² United Nations Statistics Division, 2008, "International Standard Industrial Classification of All Economic Activities, Rev. 4". Available from <http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=27> (accessed 31 December 2012).

transportation in agriculture, and from livestock digestive functions (methane). Agriculture also can emit ozone depleting substances into the environment, particularly methyl bromide that is commonly used as soil and structural fumigants to control pests in many countries. The application of and the residuals from substances in agriculture such as fertilizers and pesticides are an environmental health concern. Residuals in soil from the use of agrochemicals play an important role in determining its quality, productive capacity and pollution levels.

5.56 Agricultural waste is to a great extent composed of organic materials such as harvest remains from grain, oilseed, vegetable, and orchard crops. It also includes manure and animal output, in solid or liquid form, from livestock operations. Organic waste is a resource whenever it is reused or recycled, for example to produce organic fertilizer from biomass and manure. Other examples of solid waste include empty pesticide and fertilizer containers, old silage wrap, out of date pesticides, medicines, used oil, gasoline and diesel containers, and used tyres.

5.57 Extreme events and natural disasters (FDES Component 4) can also affect environmental resource stocks and therefore their use, as well as the production and yields of agriculture and livestock. As experienced ever more intensively by countries, droughts, floods, landslides, hurricanes, storms, etc. do impact the state of the environment and the ecological functions that support agriculture. They can severely affect soil, land and biological resources to be used or already in use as well as the productivity of these environmental resources. Extreme events and disasters can directly affect the soil and land under crops or pastures, and can also affect the water cycle and critical watersheds. They can impact relevant infrastructure and even damage the crops and livestock themselves, depending on the intensity, the duration and the nature of the extreme event and disaster, the ecosystem's resilience and the preparedness and response.

5.58 Overall, agricultural activities change the environment. They can transform ecosystems and physical conditions (FDES Component 1) via irrigation, drainage, deforestation, and the use of fertilizers and pesticides, and modify the quality and quantity of environmental resources (FDES Component 2) being used or to be used in the future, depending on the type and extent of the agricultural activities and the resilience of the environment. These changes can be qualitative and quantitative in nature. Qualitative transformation becomes an environmental issue when it concerns pollution, i.e., the biological and chemical pollution of water and the eutrophication of rivers, lakes and seas, the pollution of soil or its degradation particularly in specific sites and zones, and the air and atmospheric pollution already described under residuals. Quantitative change includes considerable land use changes (i.e., loss of natural ecosystems such as forest to pastures and crops), increased or new water stress, overuse and depletion of water, and contribution to soil erosion and degradation. Finally, agriculture may lead to both changes in physical conditions (temperature, humidity and precipitation from climate change) and to disruptions of ecological functions including biodiversity loss (terrestrial and aquatic) around agricultural areas, the introduction of invasive species, etc. These changes in the environment as a whole (FDES Component 1) retro-feed into the production process of agriculture, as an

altered state of the environment, as depicted in the arrow from environmental changes to environmental conditions and quality.

5.59 These changes in the environment will also affect human environmental health (FDES Component 5). Of particular importance are human health problems related to waterborne and airborne diseases as well as toxic substance exposure and its consequences on health. The use of toxic substances in agriculture such as those found in pesticides (fungicides, herbicides, insecticides, rodenticides, etc.) and their potential appearance in foodstuff are important environmental and health concerns.

5.60 Information on the responses of society aimed at protecting, managing, and restoring environmental resources (water, energy, soil and land) and at reducing the negative environmental impacts of agricultural activities is important (FDES Component 6). The relevant information about environmental protection expenditure, economic measures, actions and programmes aimed at protecting and restoring soil and water functions to sustainable levels, as well as promoting organic and sustainable agriculture, cleaner energy production and efficiency in agriculture, is significant. These social efforts can diminish the negative impacts and effects of agriculture on the environment and human health, and depending on the magnitude of impacts over time and across space, they could even restore the environmental quality and conditions and ensure the sustainable use of environmental resources.

5.61 The statistical description of the relations between agriculture and the environment brings together statistical topics and statistics from all components of the FDES. In addition, supporting statistics are needed that are commonly available from agricultural, economic and social statistics. Geospatial statistics and GIS are playing an increasing role in complementing traditional data in this area.

5.62 In the figures below, the FDES has been applied for the specific purpose of organizing the relevant environment statistics needed to inform about issues related to agricultural activity and the environment. Figures 5.12 and 5.13 illustrate how the contents of the FDES and its Core Set and Basic Set of Environment Statistics can be used to select and relate its relevant parts to properly describe the relationship of agriculture with the environment.

5.63 Figures 5.12 and 5.13 are based on the sequence scheme relating agriculture and the environment as depicted in Figure 5.11, and they present the FDES components, sub-components, topics and environment statistics that are considered necessary to inform about this cross-cutting issue. Figure 5.12 presents the key information to describe the relations of agriculture and the environment down to the topic level. Figure 5.13 presents the individual statistics of the Core Set and the Basic Set of Environment Statistics, organized under the different topics and components of the FDES, in a way that disaggregates the topics of Figure 5.11 to the most detailed level possible. At the end of this analysis between agriculture and the environment, commonly used agri-environmental indicators are presented as an illustration of those that can be constructed with the selected environment statistics.

Figure 5.11: The relations between agriculture and the environment

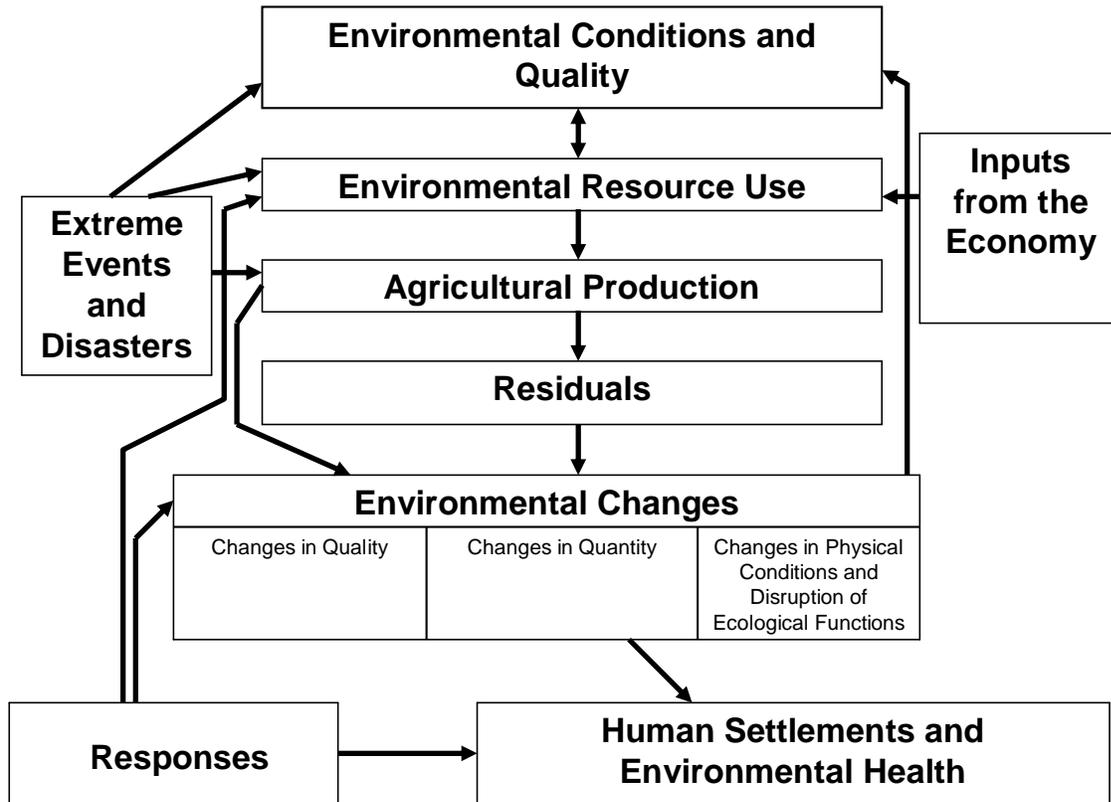


Figure 5.12: Agriculture and the environment, topic level

